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NPK REQUIREMENTS OF *VANDA* MISS JOAQUIM ORCHID PLANTS

Tadashi Higaki and Joanne S. Imamura

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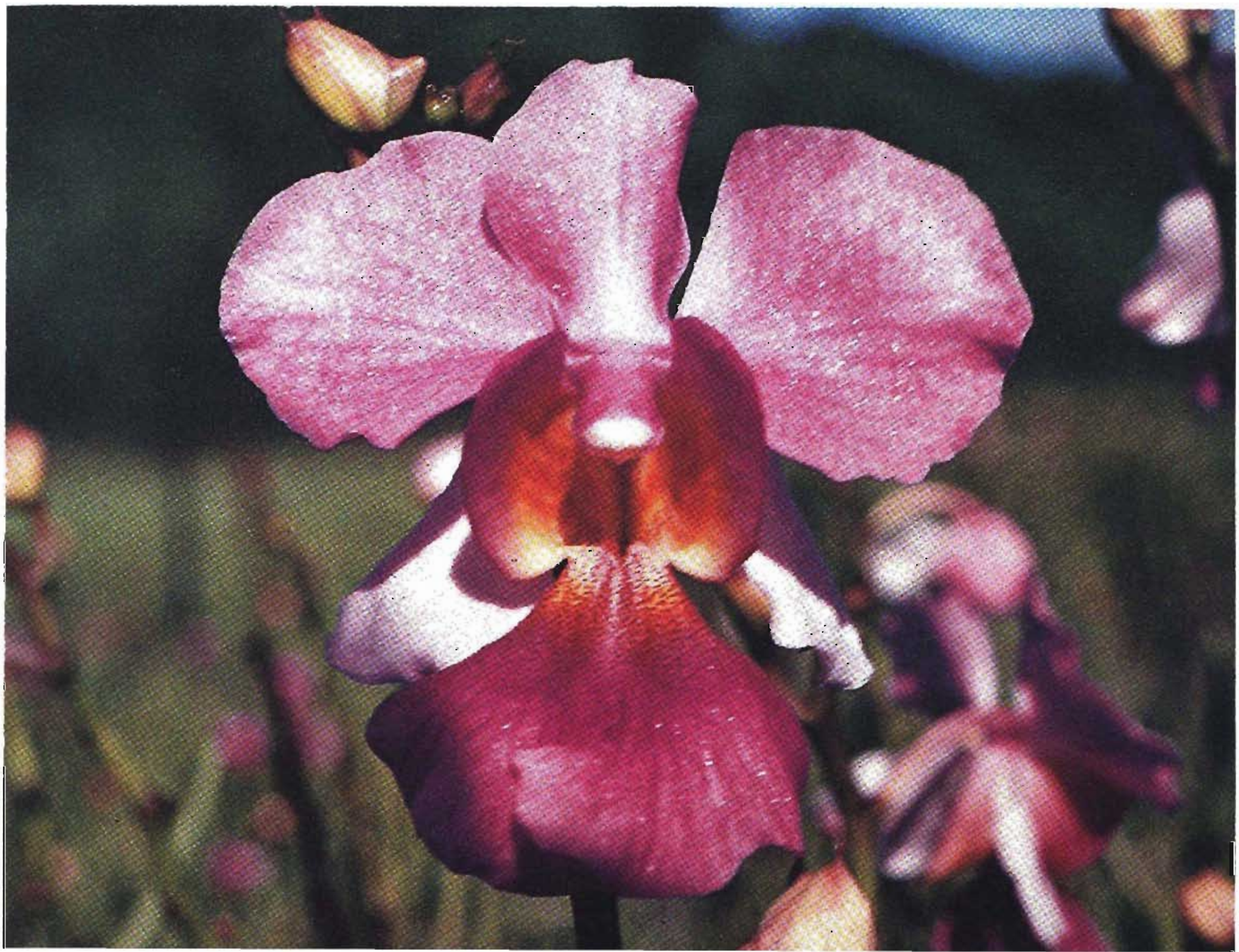

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Cover photograph of *Vanda* Miss Joaquim by Arnold Hara, assistant entomologist, Department of Entomology, HITAHR, Hilo.

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NPK REQUIREMENTS OF *VANDA* MISS JOAQUIM ORCHID PLANTS

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INTRODUCTION

Vanda Miss Joaquim is field-grown commercially only in Hawaii. Its flowers (Figure 1) are used for making leis, for decorating shops, floats, displays, etc., and as corsages and boutonnieres for promotion related to the tourist industry. In 1985, the local industry produced, on 10.6 hectares, 28 million flowers, valued at $1.1 million (2). The potential for expanded production is good. The Hawaii State General Agriculture Plan (6) has projected production valued at $2 million by 1989 (7).

Unlike most orchids, *Vanda* Miss Joaquim produces flowers throughout the year (with seasonal peaks) and grows best in open fields. Stem cuttings are planted on the outer surface of trunk sections of hapu'u (tree fern) *Cibotium chamissoi* Kaulf (Figure 2). Eight to 10 cuttings are attached to trunks 20 to 30 cm in diameter and 30 cm high. The plants set their roots in the fibrous trunks and grow upright. This method allows for maximum plants per unit area as compared to planting in beds or pots.

Present fertilizer practices include the use of chicken manure or other animal manures at 1000–1600 kg $ha^{-1}yr^{-1}$, orchid organic fertilizer (6–14–7.5), inorganic slow-release fertilizers such as Osmocote (14–14–14), and foliar fertilizers at varying rates (3).

Studies of Vanda orchid fertilization have been generally confined to pot culture in greenhouses and not to field plantings (1, 4, 5, 8). The objectives of this experiment were, first, to determine the effects of levels of N, P, and K fertilization on flower production, flower size, and plant growth when *Vanda* Miss Joaquim is cultivated on tree fern sections in open fields and, second, to obtain deficiency symptoms of N, P, and K as an aid in identifying plant nutrition problems.

METHODS AND MATERIALS

Eight 30-cm terminal stem-cuttings of orchid *Vanda* Miss Joaquim were planted on each tree fern trunk. Trunks were spaced 15 cm apart in two rows spaced 60 cm apart. This planting method simulates commercial practice. The average diameter and height of tree fern trunks were 25 cm and 30 cm respectively. The Vanda cuttings were treated with a 3 x 2 x 2, N x P x K

Figure 1. *Vanda* Miss Joaquim flower.

Figure 2. *Vanda* Miss Joaquim terminal cutting planted on a tree-fern *(Cibotium chamissoi)* trunk.

factorial treatment set in a randomized complete block experimental design with three replicates. Nitrogen levels were 0, 150, and 300 kg $ha^{-1}yr^{-1}$; P levels were 0 and 200 kg $ha^{-1}yr^{-1}$; K levels were 0 and 275 kg $ha^{-1}yr^{-1}$. Four adjacent tree fern trunks with eight Vanda cuttings on each trunk served as a treatment unit.

Nitrogen was applied as urea (46.00 percent N), P as superphosphate (9.17 percent P), and K as muriate of potash (50.64 percent K). The monthly fertilizer application per tree fern trunk was determined by dividing the total annual amount per hectare by 24,710, the number of tree fern trunks per hectare. This was then divided into 12 equal parts. The fertilizers were applied on the top surface of the cut tree fern trunk.

The experiment was conducted at the University of Hawaii's Waiakea Agricultural Experiment Station, Hilo. The plants were grown in full sunlight with no supplemental irrigation. The location receives a mean annual rainfall of 381–457 cm with precipitation throughout the year but heaviest from November to February. Fungicides and insecticides were applied as needed in a maintenance program. The experi-ment lasted three years and eight months.

Plants were allowed to grow for eight months and begin blooming before data were taken. Flowers were harvested weekly. Flower size, plant height, and stem diameter were recorded only once, at the end of the experiment. Data were taken for each plant. Flower size was determined by multiplying the flower's length by its width. Plant height was measured from the top of the tree fern trunk to the tip of the Vanda stem, since the cuttings all were planted with the tip of the terminal even with the top of the trunk. Stem diameter was measured with a caliper 30 cm below the stem tip.

RESULTS

Flower Production

The effects of the interaction of various levels of N, P, and K on flower production of *Vanda* Miss Joaquim are shown in Figure 3. The treatment of 200 kg $ha^{-1}yr^{-1}$ P and 275 kg $ha^{-1}yr^{-1}$ K at all N levels resulted in highest yields, with production increasing linearly with increasing levels of N. This indicates that effects of higher levels of N need to be investigated to obtain maximum production levels. Increasing N levels influenced yield slightly when either P or K was lacking or when both were.

Flower Size

The quadratic response of Vanda Miss Joaquim flower size to the interaction of N, P, and K is shown in Figure 4. The fertilizer treatments with N, P, and K resulted in the production of largest flowers. Lack of P was a more limiting factor for flower size than was lack of K, as treatments with both N and P but no K produced fairly large flowers. Except when both P and K were omitted, doubling the amount of N from 150 to 300 kg $ha^{-1}yr^{-1}$ did not increase flower size.

Plant Height

The effects of interaction of various levels of N and P on plant height of Vanda Miss Joaquim are shown in Figure 5. The treatment with 200 kg $ha^{-1}yr^{-1}$ P at all levels of N yielded tallest plants; heights increased directly with increase of N levels. Lack of P limited plant height, but a linear increase in height with increased N was still observed when no P was given. Potassium also was found to influence plant height, as 275 kg $ha^{-1}yr^{-1}$ K resulted in significantly taller plants (26.2 cm) than no K (21.4 cm).

Stem Diameter

The influence of various levels of N on stem diameter is shown in Figure 6. Treatment with 150 kg $ha^{-1}yr^{-1}$ resulted in largest stem diameters. Higher N rates tested in this study influenced stem length rather than diameter. The effects of P and K interaction on stem diameter are shown in Table 1. Treatment with 275 kg ha^{-1} yr^{-1} K resulted in largest stem diameter, with no significant difference related to P levels. Deficiency of K was a limiting factor for good stem diameter.

Table 1. Effects of interaction of P and K on stem diameter of *Vanda* Miss Joaquim.

Treatment (kg $ha^{-1}yr^{-1}$)		Stem Diameter (cm)
P	K	
200	275	0.61 a*
0	275	0.57 a
0	0	0.52 b
200	0	0.51 b

*Mean separation by Waller-Duncan K-ratio t test (K=100). Means followed by different letters are significantly different.

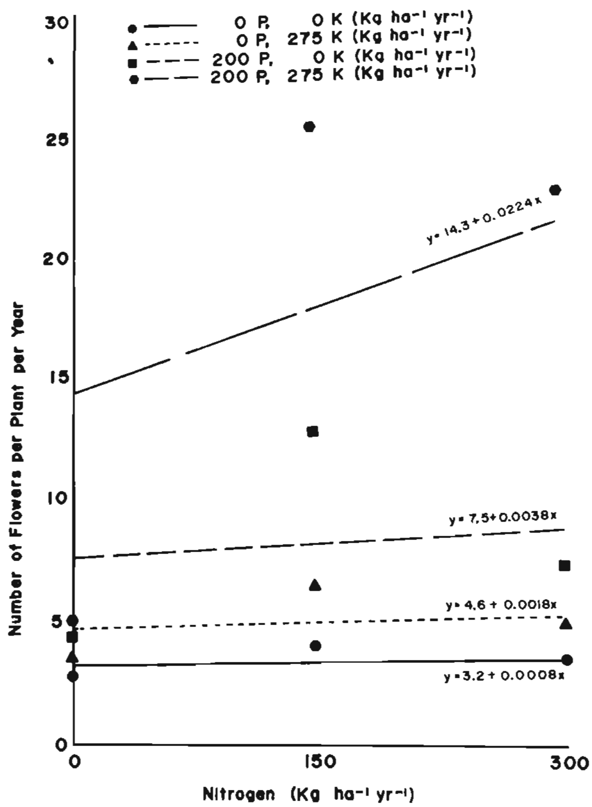

Figure 3. Effects of interaction of N, P, and K on flower production of *Vanda* Miss Joaquim.

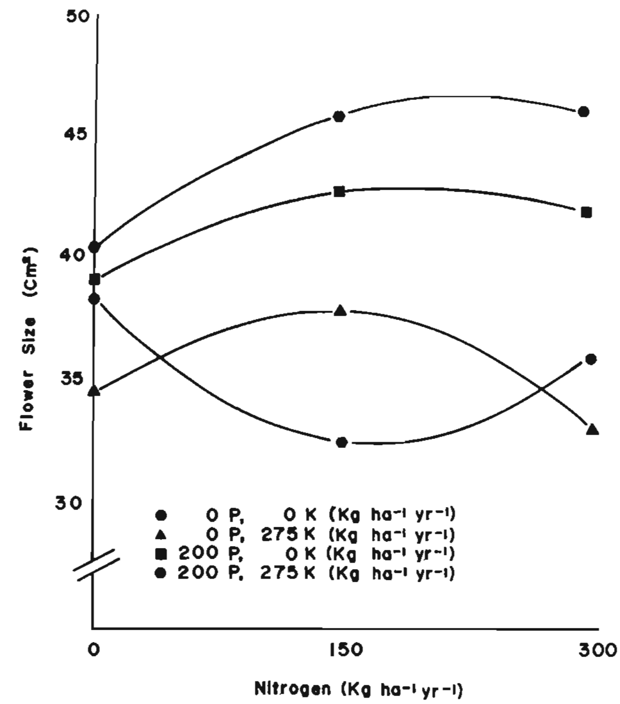

Figure 4. Effects of interaction of N, P, and K on flower size of *Vanda* Miss Joaquim.

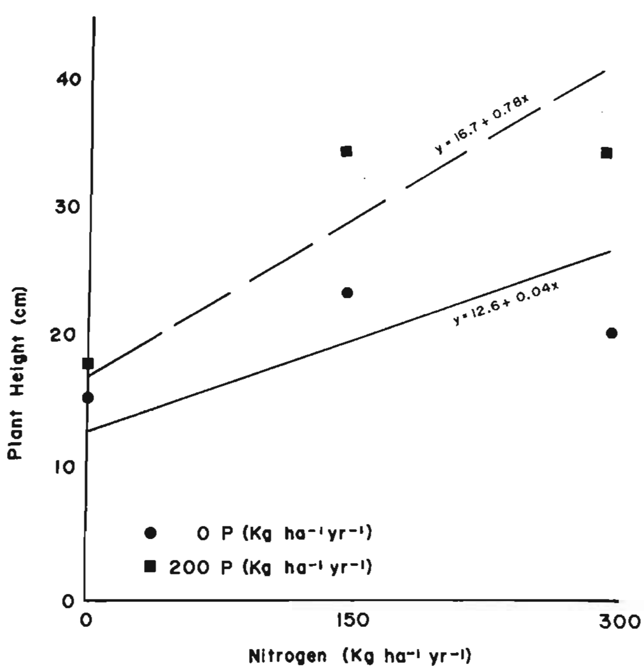

Figure 5. Effects of interaction of N and P on plant height of *Vanda* Miss Joaquim.

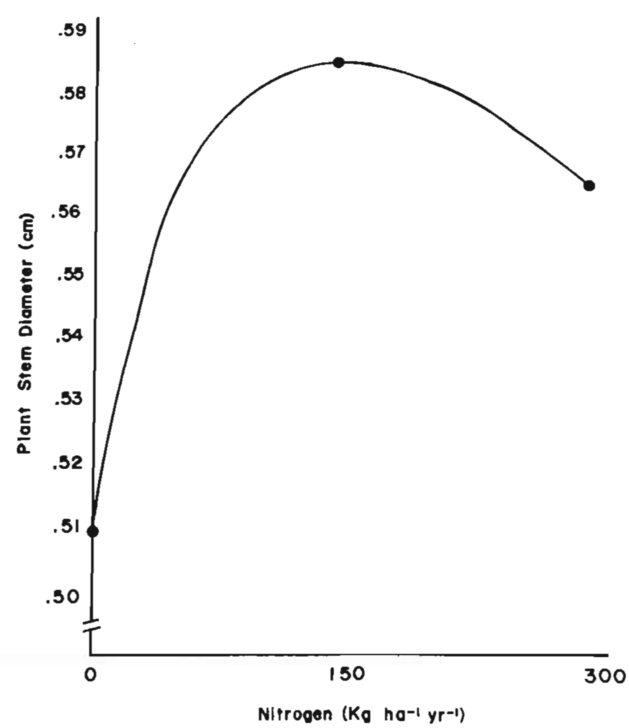

Figure 6. Influence of N on stem diameter of *Vanda* Miss Joaquim.

A. Left: N, P, and K deficient.
Right: Healthy plant.

B. Left: N deficient.
Center: P deficient.
Right: K deficient.

C. Left: N and P deficient.
Center: N and K deficient.
Right: P and K deficient.

Figure 7. Deficiency symptoms of NPK in *Vanda* Miss Joaquim.

Deficiency Symptoms

The deficiency symptoms of N, P, and K are shown in Figure 7. The NPK-deficient plant (7-A, left) is weak, thin, and chlorotic, with extreme defoliation of the lower leaves.

With N deficiency (7-B, left), the plant is relatively normal in size but shows extreme yellowing of the stem and leaves. With P deficiency (7-B, center), the plant is relatively normal in size but has purpling of the terminal sections. With K deficiency (7-B, right), the plant is weak and extremely chlorotic.

Figure 7-C shows the symptoms when two of the elements are deficient. With PK deficiency (7-C, left), the plant is relatively normal but shows defoliation of the lower leaves. With NK deficiency (7-C, center), the plant is weak and chlorotic, with extreme defoliation of the lower leaves. With NP deficiency, (7-C, right), the plant has heavy, thick stems and leaves but is extremely chlorotic.

SUMMARY

The study shows that a complete nutrient regime of N, P, and K is essential for hapu'u log culture of *Vanda* Miss Joaquim in the field. The mineral nutrient content of tree fern medium was reported to be quite low (6), and supplemental N, P, and K were found to be necessary to prevent deficiency symptoms and for optimum flower production.

Flower production increased linearly with increase in N, and application of both P and K improved total yields. Phosphorus seemed to be the most limiting factor for flower size, and if P and K were both available, 150 kg $ha^{-1}yr^{-1}$ N produced as large flowers as did twice that amount.

Application of K was necessary for good stem diameter. Diameters of stems receiving the 150 kg $ha^{-1}yr^{-1}$ N treatment were larger than those receiving 300 kg.

Plant height increased linearly with increase in N, with application of P further increasing height. Plants were also taller when K was available than when no K was applied. Taller plants may not be advantageous commercially, as they may require support, are more subject to wind damage, and make harvesting of flowers more difficult.

Higher levels of N may increase flower production and plant height. Further study is needed, however, to derive a level of N that allows a balance of good plant height with optimum flower production.

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